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Maine Agricultural Experiment Station

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POULTRY WORK AT THE MAINE STATION.

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AGRICULTURAL EXPERIMENT STATION
ORONO, MAINE.

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BULLETIN No. 157

POULTRY WORK AT THE MAINE AGRICULTURAL EXPERIMENT STATION.

By Chas. D. Woods, Director.

During the past year a number of changes have occurred in the poultry work of the Station. It is desirable that a clear statement should be made, setting forth the facts regarding these changes. It is the purpose of this bulletin to give such a statement. It is proposed to consider the following topics in order: The poultry work of the Station up to 1908; poultry investigations now under way; general outline of plans for future work with poultry.

The Poultry Work of the Station Up To 1908.

Poultry investigations were begun at the Station in 1897. In that year a poultry breeding house was built. In the fall birds were installed and experiments begun. The work was in charge of Professor G. M. Gowell. An account of the plant, and a brief statement of the experiments begun that year were given by Professor Gowell in the Annual Report for 1897 (pp. 97-103). At the outstart the experiments simply dealt with the practical questions of managing the birds in the new house so as to maintain their health and productiveness. In the second year of the work (1898) an experiment in breeding fowls for increased egg production was begun, with the invention of a trap nest and the taking of records of the egg production of individual hens. This work has continued to the present time. From the beginning of the work there has been carried on one other general line of poultry investigation besides breeding for egg production; namely, studies in poultry management, including housing, feeding, rearing chickens, and other equally important matters.

The work of the Station in these two directions (breeding for egg production and poultry management) has attracted wide attention not only in this country but abroad as well, and has been very generally held to have been of notable practical benefit to the poultry industry at large. A brief "account of stock" of what has actually been accomplished in the two general lines of poultry work followed will be useful here. The work in poultry management will be first considered.

THE CURTAIN-FRONT HOUSE.

Of all the improvements which have been made in poultry management at this Station undoubtedly the so-called "curtain-front system" of housing ranks first. Up to the time when Professor Gowell began the first tentative experiment in the direction of making a more open house for laying poultry it was practically universally believed by poultrymen that in order to get good winter egg production it was necessary to imitate in the poultry house, so far as possible, summer conditions. The Experiment Station itself constructed its first poultry house on the plan of a tight house with a system of supplying artificial heat. It was very soon demonstrated after the "curtain-front" principle was tried in a small house (the so-called "Pioneer house" of Station bulletins) that the old idea of the necessity for a warm house for winter egg production was essentially wrong. It clearly appeared that a low temperature in itself had no bad influence on egg production during the winter months. Further it appeared that getting the birds into the open air every bright, sunshiny day during the winter was a great stimulus to egg production. This is practically what the "curtain-front" house does. During bright days the curtains are up and to all intents and purposes the birds are in the open air. The house, however, gives two conditions which could not be duplicated in the open air during the winter months. First, the birds are protected from drafts and, second, they scratch in a dry litter. The general idea that the lowness of the temperature does not matter in egg production provided the birds have plenty of fresh air and the house is dry, has proved itself in the experience of the Station a correct one.

The essential correctness of the underlying idea in this "curtain-front system" of housing is further indicated by the fact

that it has been widely adopted by practical poultrymen all over the world. In fact it may now be said that this is the dominant plan of housing poultry for laying purposes at the present time. While the Station makes no claim that this idea is absolutely original with itself, still the fact remains that at the Maine Experiment Station this scheme of housing was first tried on any extensive scale.

DRY MASH FEEDING.

Probably next in practical importance to the "curtain-front system" of housing in the achievements of the Station in poultry management should stand its demonstration on an extensive scale of the value of the dry mash system of feeding laying birds. Here again the Station makes no claim of absolute priority. It is a significant fact, however, that the dry mash system of feeding which at the present time is probably more widely used than any other system of feeding poultry by the largest and most up-to-date poultry plants throughout the country, was very little used until after the appearance of the bulletins of this Station detailing its success with the method. It is, furthermore, a significant fact that anyone who will take the trouble to read the correspondence and advice columns of the leading poultry journals in this country will find that the Maine Experiment Station formula for mixing the dry mash feed is more often recommended by the editors of these journals than any other.

CRATE FATTENING.

Another line of experimentation in poultry management at the Station which was at the time it was carried out pioneer work for this country was the demonstration of the practical value of crate fattening of chickens to be sent to market. While crate fattening had long been practiced in Europe before the Station did any work on the subject it was neither generally known nor generally practiced in this country. The Station clearly demonstrated the value of the method by its own experiment. It cannot be doubted that the results of these experiments have stimulated many American poultrymen to try crate fattening for themselves, and in so far have contributed to the commercial development of the poultry industry in this country.

METHOD OF REARING CHICKENS.

Finally one other line of work in poultry management which has been developed at the Station and which has attracted wide and favorable attention among practical poultrymen is the study of the best methods of rearing chickens. While it is by no means to be supposed that the last word has been said on this subject it is a fact that the methods of rearing chickens which have been tried at this Station and have been published in its bulletins have been adopted by many poultrymen. This can only be considered as an indication that these methods, if not the best possible, are, at least, regarded by practical poultrymen as better than what they had been using in the past.

FARMERS' BULLETIN ON POULTRY MANAGEMENT.

Before leaving the subject of the poultry management work it may be stated that at the request of the Bureau of Animal Industry a Farmers' Bulletin of the U. S. Department of Agriculture on methods of management of poultry practiced at the Maine Experiment Station is now in course of preparation. The demand for this information the Station has never been able to meet with the editions which it was possible to print of its own bulletins.

BREEDING FOR EGG PRODUCTION.

Turning now to the work of the Experiment Station in breeding for egg production it should be said that at the time when this work was undertaken it was truly pioneer work. The larger domestic animals like beef and dairy cattle, sheep, horses, etc., had been bred from earliest times for utility purposes and had been greatly improved by such breeding. No serious attempt had ever been made, however, to apply any consistent plan of breeding poultry for such a pure utility point as egg production. The breeding of poultry for fancy or show points (feather, form and the like) had long been practiced and had reached a high state of perfection. It was felt on the inauguration of the work that in consideration of the fact that the vast majority of all domestic fowls were kept for their value as producers of either eggs or meat or both that it was highly desirable to learn whether better qualities in regard to these

utility points could not be bred into standard varieties of poultry.

TWO EXPERIMENTS PLANNED.

The general plan of the investigation on this matter was simply to try on a large scale selection experiments in egg production. The working basis of the original plan was the assumption that small fluctuating variations in egg production were inherited. Proceeding on this assumption two experiments were planned by the writer. One of these experiments had as its object to determine whether by breeding only from relatively high layers the average annual egg production of the flock could be increased. This experiment was carried out by Professor Gowell through 9 consecutive years. The limit of "relatively high laying" was taken at 150 eggs. All birds laying more than that in their first laying year were used as breeders during the 9 years which this experiment was continued. The cockerels used in this breeding experiment were sons of birds laying 200 or more eggs in their first laying year. The second experiment planned which was of obviously equal importance to the first, was intended to determine whether if only relatively poor laying hens were used as breeders it would be possible to lower the annual average egg production. This second experiment was never tried, a fact which is greatly to be regretted in the light of what is now known regarding the results of the first experiment (see p. 210 below). A word may perhaps be advisable to point out clearly why it was necessary to perform this second experiment before any definite conclusions could be drawn as to the meaning of any results obtained in the first experiment. Suppose that in trying the first experiment favorable results are obtained, i. e., that the annual average production increases from year to year concurrently with the selective breeding. Is it to be concluded that the breeding is the cause of the increase? Such a conclusion obviously cannot be drawn, if, *as was the case in the actual performance of this "breeding for egg production" work at this Station,* there are made improvements in housing, feeding and other details of management, each one of which by itself might tend to increase annual average egg production. Nobody can tell how much of the observed improvement is due to breeding and how much to housing, feeding, etc.

EFFECT OF THE BREEDING EXPERIMENT UPON PRACTICE.

Leaving this matter for the moment it may be pointed out that whatever the detailed results of the experiment in breeding fowls for increased egg production, there can be no doubt that the experiment itself has served as a decided stimulus to the better breeding of poultry in this country. A great number of poultrymen at the present time are using trap nests and selecting birds for breeding with reference to their performance in egg production. In the advertising columns of every poultry journal will be found advertisements of strains of all of the standard breeds "bred to lay." At the time when the work of this Station in this direction was begun it would have been extremely difficult, if not impossible to find any poultryman who was making any systematic attempt to increase the egg production of his flock by breeding. Whatever the results of the Station's experiment, and whether or not methods of breeding based on its supposed results have a sound foundation, it is a great gain to have brought about a wide spread recognition of the importance of improving the methods of breeding poultry for egg production.

Another respect in which the breeding work of the Station has been of great value lies in the fact that in the course of the experiment a remarkable collection of data regarding egg production has been accumulated. Since 1898 trap nest records of substantially all the birds kept in the Station's poultry plant have been made. It is probable that nowhere else does there exist a set of records of egg production covering a period of 9 years and including several thousand birds. Quite regardless of the outcome of the breeding experiment itself these records collected in the prosecution of the experiment have a definite, permanent and considerable value.

STUDY OF THE EGG RECORDS.

Up until the summer of 1907 no particular attempt had been made to analyze these records of egg production and to see what light they threw on the laws governing the process itself. In July, 1907, the department of biology of the Station was organized and commenced its work. One of the first tasks undertaken in this department was the analysis of the egg record

statistics. The complete analysis of the statistics is an extremely laborious task and will take considerable time for its completion. It is gratifying to state, however, that the first part of this work has been finished and is now in the hands of the U. S. Government printer awaiting publication. This first portion of the discussion of the records of egg production deals with the annual records. That is to say, that unit of this part of the investigation is the total production of the birds during the first laying year. A brief summary of some of the more significant results of the study of annual egg production which have a practical bearing on the future policy of the Station in its poultry work are included here. It is to be understood that this summary is a direct compilation from the extended and detailed paper by Doctors Raymond Pearl and F. M. Surface, the biologists of the Station, setting forth the results which are to be published as a bulletin by the Bureau of Animal Industry. In such a summary the evidence on which apparently dogmatic statements are made obviously cannot be given.

The chief reason or indeed necessity for making a detailed study of the annual egg production during the course of the breeding experiment obviously lies in the following considerations: The initial purpose of the experiment was to find a way to breed poultry so that an increase in egg production might be obtained. In order to get at this knowledge a specific method of breeding was tried during a period of 9 years. The only way in which it is possible to get any light at all as to whether this particular method of breeding is the best or even a good one to attain the desired end is to find out precisely what happened in egg production in each year covered by the experiment. If the method of breeding is a good one for its desired purpose then it would be expected that, barring accidents, in each successive year of the experiment there ought to be an increase in the average production of the flock. As a result of unavoidable accidents it might happen in any such experiment that in a particular year the average production would drop below that for the preceding year. Consequently in order to form any just estimate of the value of the method of breeding it is necessary to consider the results over the whole period of the investigation together. That is to say, the general trend of the egg production over the whole period must be taken account of and

the minor fluctuations in individual years must be neglected. The statistical examination of the annual egg records therefore, derives its justification from the necessity of determining what the value to the practical poultry man is of the method of breeding which has been followed in this experiment at the Station.

CONCLUSIONS REACHED FROM THE ANNUAL RECORDS.

The detailed study of the annual records, using adequate mathematical methods of analysis leads to the following conclusions:

I. There is a large amount of variation among individual birds in respect to annual egg production. The range of variation extends from zero to approximately 250 eggs in the records of the Station. The *amount of variation* in regard to egg production is substantially the same at the end of the selection experiment as it was at the beginning. That is to say, after 9 years of selection with respect to egg production the birds breed no truer to a definite type of egg production than they did at the beginning. It will be recognized by every stock breeder that this is an important fact to be taken into consideration in passing opinion on the value of the method of breeding poultry which was tried in the experiment.

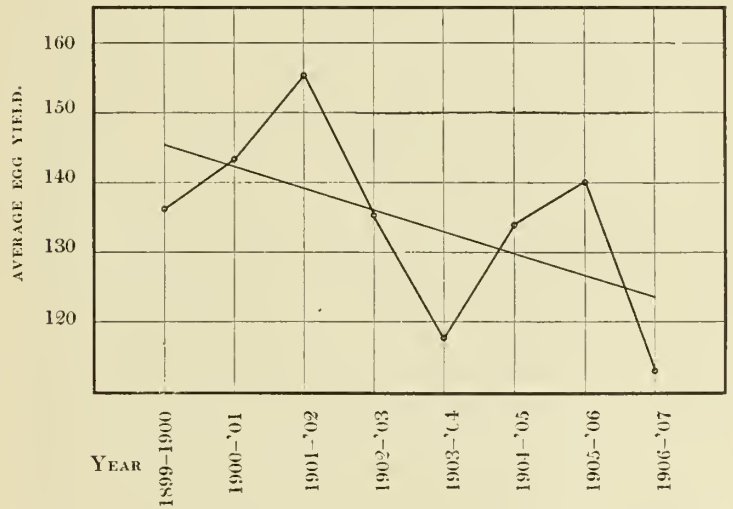
II. The general trend of average annual egg production has been slightly downward throughout the course of the experi-

Year and pen.	Birds completed the year.	Eggs laid.	Actual average production.
1899-1900	70	9,545	136.36
1900-1901	85	12,192	143.44
1901-1902	48	7,468	155.58
1902-1903	147	19,906	135.42
1903-1904	254	29,947	117.90
1904-1905 * 50 bird pens	283	37,943	134.07
1905-1906 * 50 bird pens	178	24,827	140.14
1906-1907 * 50 bird pens	187	21,175	113.24

* In these years the "floor space" experiments referred to below (p. 212) were conducted. Birds were kept in flocks of 50, 100, and 150 birds each. The highest annual averages have been made in each year by the 50 bird flocks. Consequently only these are included in this table. To include the others would simply be to lower the averages of these years below the figures given in the table.

ment. This is shown in the following table which gives the annual egg production for the years 1899 to 1907.

It will be seen from the last column of this table that the annual average production increased during the first three years of the experiment. A second maximum was reached in 1905-1906. The general trend of the figures, however, can best be appreciated if they are shown graphically as in the following figure.



Showing change in average annual egg production.

The zigzag line in this figure is the plotting of the last column of the table. The straight line is the line which best fits this zigzag line as determined by accurate mathematical methods. The downward slope of the lines is apparent.

It should be said that in the later years of the experiment (from 1902 on) there occurs in all but one year some accident which may be held to have diminished the egg production below what it should normally have been. In the detailed discussion of these figures in the complete report the most liberal allow-

ance possible is made for these accidents and it is there shown that even after making these allowances the general trend of the line of annual averages is only horizontal. That is to say, *there is no evidence of any increase in the average production of the flock.*

It will be noted by those who have followed the previous reports of the Station with reference to its poultry breeding work that the averages set forth in the above table do not agree with those which have previously been published. It is an unfortunate fact that the averages published in the earlier reports of this Station were in several cases in error. So far as can be learned from the records themselves the causes of these errors fall into two categories: namely, (a) faulty methods of handling the statistical material and (b) arithmetical mistakes. As soon as the detailed paper of which the present discussion is an abstract appears it will be possible for any interested person to verify for himself the averages which are given in the above table since in the complete paper there will be published the annual egg production of every single bird during the whole 8 years for which complete records exist.

III. Another point which throws light on the value of the method of breeding for increased egg production lies in the consideration of the relative number of "drones" and of high producers in each successive year of the experiment. Defining a very poor laying hen as one which produces less than 45 eggs in its first laying year and as an exceptionally good laying hen one which lays more than 195 eggs in its first laying year, it is found that there has been no substantial change during the course of the breeding experiment in the relative proportions of either very high layers or very poor layers in the flocks of the successive years. At the beginning of the experiment there were relatively few "drones" in the flock. The relative proportion of such has not practically changed.

IV. During the 3 last years of the breeding experiment there was carried on in connection with it an experiment on the effect of the amount of floor space per bird and the size of the flock on annual egg production. Without going into the details of this experiment, which were entirely consistent in the whole of the

3 years, it may be said that it clearly appears that these factors of flock size and floor space have a definite and measurable effect on the average annual production. This effect is quite considerable in amount. The bearing of the results of this floor space experiment on the breeding experiment with which we are chiefly concerned here lies in the fact that the figures which will be given in detail in the complete paper show beyond any doubt that these environmental factors can, even after the close selection for more than 5 years, still cause very marked changes in the character (egg production) which it was hoped to fix in the strain by breeding. There is a considerable amount of detailed evidence which is presented in the complete paper all of which tends to show that the quality of high productiveness cannot be regarded as any more a fixed characteristic of the Station's strain of Barred Plymouth Rocks now than it was at the beginning of the experiment.

The general conclusion regarding the results of the breeding experiment may be quoted from the complete paper. "The practical conclusion to be drawn from the results of this breeding experiment seems to the authors to be clear. It is that the improvement of a strain of hens in egg producing ability by selective breeding is not so simple a matter as it has been supposed to be. Nothing could be simpler than breeding from high producers to get high producers. But if this method of breeding totally fails to get high producers—in other words, if the daughters prove not to be like the mothers in egg production—it cannot fail to excite wonder as to whether the simplicity of the method is not its chief (possibly its only) recommendation. Anyone who makes a thorough, first-hand study of an extensive selection experiment carried out, as was this one, by the so-called German method without testing of the centgener power of the individual organisms, cannot fail to be impressed, we believe, with the fact that the improvement of a race by selective breeding is a vastly more complicated matter than it is assumed to be by those who maintain that one need only to breed from the best to insure improvement. The supposed "facts" of heredity on which the practical stock breeder (working for utility points) operates are in very large part inferences rather than facts. What is needed more than anything else for the advancement of the stock breeding industry in all its phases

is an accumulation of definite knowledge of the fundamental principles of the hereditary process. All breeding operations must be based on the laws of inheritance in organisms. The practical stock breeder is able to work out the *applications* of these laws for himself. What he most needs is broader and deeper knowledge of the laws themselves. This knowledge must come from thorough-going, purely scientific investigations."

THE EXPERIMENT A SUCCESS AS AN EXPERIMENT.

It must not be concluded from what has been set forth above that the experiment in breeding for egg production is to be regarded as having failed. To draw such a conclusion is to misunderstand completely the purpose with which the work was begun. The purpose of the experiment was to find out whether high egg productiveness could be bred into a strain of fowls by the method of breeding practiced. The experiment has answered this question in the negative. There could be but one of two answers to the question. It is no more to be counted as a failure of the experiment if the answer turns out to be "no" than if it had turned out to be "yes." To have the question answered so clearly and definitely is a great gain. It clears the ground to start a new experiment to see whether another method of breeding will make it possible to breed high egg production into a strain.

Furthermore it must not be concluded that the strain of Barred Plymouth Rocks carried by the Station is at the present time anything other than an excellent strain in respect to egg production. In spite of the fact that there is no evidence of any gain in respect to egg production during the course of the breeding experiment the strain itself is without doubt an unusually good one in respect to this character. When the number of birds carried and the length of time over which trap nest records exist are taken into consideration it is doubtful if there is any where a strain of Barred Plymouth Rocks which surpasses the stock of the Station in record egg production. The stock of the Experiment Station poultry plant is unusually healthy and vigorous. None of the infectious diseases which so commonly cause serious difficulty in the operation of large commercial poultry plants has ever appeared in the Station's

flocks. The small annual death rate which has existed throughout the poultry experience of the Station can only be regarded as a normal mortality for hens fed and managed for high egg production. The inherent value of the strain of Barred Plymouth Rocks with which this work has been done is attested by the almost uniform satisfaction which has been expressed by those who have bought either eggs or cockerels from the Station for the purpose of infusing new blood into their own flocks.

Poultry Investigations Now Under Way.

In December, 1907, Professor Gowell resigned his position on the Station staff in order to devote his entire time and attention to his private poultry interests.* On January 1, 1908, the poultry investigations of the Station were put in charge of the biologist, Dr. Raymond Pearl. This change in the supervision of the work has not involved, nor is it anticipated that it will cause any essential change in the general policy of the Station relative to poultry work. The Station will continue in the future as in the past to investigate problems relative to poultry husbandry; problems will be chosen which are of fundamental practical significance. The work at present and in the future on poultry will, as hitherto, fall into two main lines; namely, investigations in breeding and investigations in poultry management.

IMPROVEMENTS IN METHOD.

During the present year a number of improvements have been made relative to the methods of conducting poultry work on a large scale and at the same time with scientific accuracy. A system of keeping pedigree records has been devised and put into practice which makes it possible with a minimum expenditure of time and labor and with entire accuracy to keep exact pedigree records of every individual chick. Hitherto the pedigree records in connection with the breeding work of the Station have been of a general rather than a detailed character. It is believed to be of fundamental necessity that the individual father and mother of each particular chick shall be known. In

* It is with feelings of the deepest regret and sorrow that one has to record that while this bulletin was passing through the press Professor Gowell's death occurred.

this way it will be possible to trace exact individual pedigrees just as they can be traced for pure bred registered animals of any kind.

In an experiment looking to the improvement of egg production it is essential that the trap nest records of egg production should be absolutely accurate within the limits of human possibility. It has been found that the trap nest which has been used in the Station's poultry plant throughout the breeding investigation, while sufficiently accurate for ordinary, practical purposes, falls short of that degree of accuracy which is necessary in scientific work on pedigree breeding for egg production. The chief defect from which the old trap nest suffers is that it is possible for a bird to lay in the front of the nest without springing the trap and hence without being caught and making a record for the egg. Actual test indicated that this laying in the front of the nest more or less frequently happens. To remedy this defect a new trap nest has been devised and is now being installed in the houses. This best overcomes the few objections which exist to the old type of nest. A description of this new trap nest will be published shortly in a bulletin relative to the poultry work.

In addition to the breeding work particular attention is being paid during the current year to problems connected with fertility, and hatchibility of eggs and the rearing of chickens. It is expected that during the year a bulletin giving notes relative to new points in poultry management will be published.

Plans For Future Work With Poultry.

As has been said, the poultry work in the future will fall into the same two general lines as in the past; namely, breeding investigations and poultry management investigations. It does not seem practicable at this time on account of limitations of space to set forth in detail the complete plans for experimentation with poultry which the Station either has under way or expects to undertake soon. These detailed plans will be described in bulletins dealing specifically with the poultry investigations. It is desirable, however, that a general idea of the way in which it is expected that the poultry work will develop should be given here.

POULTRY MANAGEMENT.

The poultry management investigations will be of the same general character as those hitherto conducted. From year to year, as in the past, definite practical experiments on isolated topics in poultry management will be tried with large flocks of hens.

POULTRY BREEDING.

Two general problems will be investigated in this direction. The first of these is whether it is possible by another method of breeding than that which has been tried at the Station to fix the characteristic of high egg production in the Station's strain of Barred Plymouth Rocks. It is not necessary at this place to enter upon a detailed discussion of what the method of breeding to be tested in this experiment is. It may in general be said, however, that it will be an attempt to apply to poultry breeding for a utility characteristic the same fundamental principles in breeding which have led to such brilliant and important results in the breeding of cereals by the Hon. W. M. Hays, Assistant Secretary of Agriculture, and of Doctor Hjalmar Nilsson at the Swedish Experiment Station at Svalöf, Sweden. The fundamental idea underlying the method of breeding which is to be tried is to base the selection of breeding stock on mutative rather than fluctuating variations. The past experience of the Station demonstrates that the individual *performance* of a hen in respect to egg production is not necessarily an adequate indication of her desirability as a breeder in attempting to found a strain of high laying hens. It is the purpose to test the *transmitting* power of individual hens and cockerels always with regard to the character egg production just as in wheat breeding work the centgener power of an individual head is tested. The experiment will have a very considerable scientific interest derived from the fact that it will be the first attempt on a large scale to apply to practical animal breeding those principles which are proving of such wonderful value in plant breeding.

In addition to the experiment in breeding for increased egg production an experiment will be tried to determine whether by a combination of hybridization and selection it will not be possible to breed a strain of fowls of superior quality for table use. A development of the meat type of poultry has been very much

neglected in this country as compared with England and France. It is felt to be of considerable importance to conduct experiments likely to give results of practical significance for this phase of the poultry industry.

While the poultry work of the Station will be concentrated on practical problems which every poultryman wants light upon, the treatment of these problems will be broad and thoroughly scientific. The problems of breeding are exceedingly complicated and difficult ones. No narrowly conceived or carelessly executed experiments will ever give any results of any permanent *practical* value in this field. The underlying fundamental laws of heredity must be investigated before the Experiment Station or anyone else can tell the practical breeder how to proceed to get what he wants and be certain of it. The aim of the Station in its breeding work *will not be in the future, as it has not been in the past, simply to produce an improved strain of hens.* It is not a part of its function to enter into the commercial poultry business. The function of the Experiment Station is to experiment, and by experimentation to learn, in so far as may be, facts and principles which will help to advance the theory and practice of agriculture.